A Forever Composed of Nows: The Misimagination of Mathematics

An Honors Thesis (HONR 499)

by

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Abstract

Mathematics and philosophy have always been closely tied, and perhaps this relationship first began when humans tried to write down the mathematical discoveries they were making. In this translation of thoughts into words, certain aspects were not properly encoded or even misinterpreted. But even though this, mathematics still evoked certain emotions from people across all fields. A pure mathematician can look at a theorem and see its ebb and flow; perhaps the curve of an integral sign or the way an n x n matrix seems to contain everything but nothing is a source of beauty. A middle school student can see the simplicity of formulas, but also the infinite amount of possibilities it can hold. Mathematics is all about how we choose to read and interpret what we encounter. If given the opportunity, can we apply this interpreted beauty to our own lives? The answer to this question rests on the idea that we can read and comprehend the mathematical jargon in a way that is meaningful and purposeful.

Acknowledgements

I've been looking forward to writing this section since this whole process began, so let's hope I can live up to my own expectations.

To my mom and dad, thank you for giving me my curious spirit. Thank you for never saying I was crazy for embarking on this process, and thank you for being understanding enough to let me spread these wings and see if I could fly. Your love has been my fuel.

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Readers, enjoy. This is my attempt at mapping a world that changes the world.

Artist Statement

"Guided only by their feeling for symmetry, simplicity, and generality . . . creative mathematicians now, as in the past, are inspired by the art of mathematics rather than by any prospect of ultimate usefulness."
-Eric Temple Bell

Asking a mathematician when the moment he or she first fell in love with math can come with a variety of answers, probably varying from grade school encounters to graduate degree mega problems. I would like to consider myself a mathematician because at its basic level, a mathematician seeks to find answers to questions. And so I will answer the burning question: what was the moment that caused you to fall in love with math?

Math had always been this subject for me that I either understood or I pretended to understand. For many years, this love meant memorizing algorithms that I used every day but did not know the why or how behind. In seventh grade, I remember the day we learned that subtraction is really just adding a negative and coming home and proving it to my parents. It was not until this year did I realized that subtraction required the notion of zero pairs, and so this exemplifies what subtraction is at its core. Now this love has transformed into finding parallel lines in buildings and traveling along hypotenuses discovered in nature.

Recently, this love turned into applying mathematics to various contexts in my life and finding the relationship between them. From Nietzsche to de Beauvoir, I have found ways to connect the mathematics I grew up trying to understand to a new world that I am just as unfamiliar with. I found meaning in placing parameterization next to Kant and Euler's work next to the birth of Christianity. What I discovered is quite fascinating. I discovered a relationship between two worlds that for so long seemed impossibly distant. No longer was I memorizing algorithms; rather I was building bridges stronger than ever before.

I was reimagining a world that I forgot existed. Reimagining is about uncovering connections and then redefining your outlook on the world. You can reimagine every day, multiple times a day if you desire. It's your method. So my method became writing. Mathematics finally became an art.

And so I return back to the Bell quote that I began this introduction with. Not only do I consider myself to be a mathematician, but I also consider myself to be a creative one. I am inspired to love my field by the art in which I am immersed.

What you will soon read is the love I have for mathematics and philosophy. Combined, it creates a beautiful story of finding the light within your own life to create relationships between two seemingly opposite sides of the world. This rests on us resolving our own place in the world as being very small, yet so very important. It is truly about being thankful for our own little infinity.

The Transcendental Self

Mathematics, at its core, is about the relationship between known and unknown quantities, between the concrete and the abstract, between the finite and the suspended. Mathematics enables its users to relate with a special side of the world, a side that manufactures a different reality than the one in which we currently live. Some then become spectators to this great world, and even fewer place themselves in a position to interact with this world.

When we seek to interact with math, we place ourselves in the position to misimagine the symbols and letters, to not quite fully define a theorem, and to get lost in the translation between what we perceive numbers to represent. Oftentimes, interacting with mathematics requires an element of creation. I seek to offer up a logical argument: first, creating is terrifying. Second, everyone creates. The conclusion follows then that everyone is terrified. Artists, actors, inventors, are all creators. But the elderly neighbor down the street is also a creator, and so is the shy girl in the corner, and I am and you are. You create your self. You create you.

My creation over the past four years was largely in part because of this love I had with math, this search I had to create something meaningful in a field that has been around for thousands of years. That was hard; and it still is hard. On one hand, I was interacting with texts by Marcus Aurelius, Lucretius, and Aristotle in ways I had never done before. I was talking to the text and it was responding back, giving me a chance to offer my thoughts and to have those thoughts questioned and disputed. On the other, I was reading up on the history of mathematics. I was learning the whys and hows behind such simple things as parallel lines and angle congruencies. And so I decided to merge those two worlds together. I was the mediator between discussions weaving together parametric equations with the definition of the self, and I felt like I was creating something.

I hope to be able to bring you along on this journey that I have been taking for several years now. I will open from a selection from *Meditations* by Aurelius: "The work of universal nature is to translate this reality to another, to change things, to take them from here and carry them there. All things are mutations, but there is equality too in their distribution. All is familiar; no cause then for fear of anything new." Let us begin with translating this reality into another, which my friend, is what I call the transcendental self.

In over 5000 years of mathematical history, several individuals have placed themselves on the highest pedestals. One such individual was Georg Cantor. His developments in the philosophy and mathematical possibility of the infinite created a gateway for other such mathematicians to experiment with the parameters of what appeared to be a finite area of study. Pushing the boundaries of set theory, Cantor had several groundbreaking theorems about the countability of certain sets, and this leads to an interesting discussi

The theorem in question is as follows: the set of transcendental nu

Should be "integer"

To fully be able to engage with this idea, one must underst

transcendental numbers and what it means for a set to be uncount

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is a number that is not a root of a non-zero polynomial equation with rational coefficients. Examples of such numbers are π and e, but these are not the only two numbers with this classification. For a set to be countable, according to Cantor, the set has to be in a one-to-one correspondence with the natural numbers. Thusly, a set is considered uncountable if it cannot be placed in this one-to-one correspondence. This opens up a great philosophical debate. It is mathematically known that the set of transcendental numbers is uncountable, yet it is almost impossible to prove that numbers fall into this category.

Like many mathematical ideas, this principle can be expanded to a realm that includes humanity. Consider the concept of creation. It is generally known that all humans create, and that our most valuable creation is the self. There is a certain level of suffering that occurs when creating the self, and it stems from knowing that once we create ourselves, we allow others to judge us for what we are without allowing us to be a part of that judgment process. We all can testify to the hard reality that is reconciling with this suffering. Some of us turn to concealment in order to hide our own suffering. In his essay "Existentialism is a Humanism," Jean-Paul Sartre discusses this need for perfect concealment, or what we commonly call a mask. It is the one personality trait that allows us to choose and make ourselves, yet on the other hand, concealment is the one impossible attribute that we cannot transcend because of the sheer number of choices that are placed in front of us. When we discard options, they must go somewhere, and perhaps they go into the masks of others. We are reminded of those statements we often hear from our elders that usually begin with "when I was your age...". I can look at another person and be reminded of past decisions, vague memories, and happy moments of a life that may feel as if it was ages ago. And so when we look at others, we see the remnants of ourselves. There may be other instances when we in others what we wish we could have done. It is not necessarily a jealousy, but I think it is a longing to know what would have happened if. If I had said hello to that stranger on the street. If I had tried harder. If I had worked up the courage. It is in this metaphorical mirror that we find that the mask does not actually exist; instead it is a reflection back of our past and potential selves.

Sartre then makes a transition and discusses this idea of anguish—an anguish caused by humankind's realization that we choose who we want to be, but the world can choose who we are represented as. Should we be surprised that this feeling exists when the entirety of humanity

is so fixated with this idea that history can repeat itself and that our ancestral lineages ultimately predict our future actions? Perhaps the answer is yes, as with each decision we make now, we are altering someone else's future. The new future changes every second, every hour, every day when a new mask is made. And so when we look at people and let people into our life, we tend to seek something that we can hold so firmly in our hands that our knuckles become white with the promise of something different. That is not to say that we manufacture the people around us, but maybe we look at others and just see ourselves—because no matter what changes around the world or with the masks of others, for that snapshot in time, we see ourselves. In this infinite perimeter, we find a bounded area. This is a bounded area that contains all of the ghostly versions of us—the parts of our past that refuse to be confined by a grave. If we assume that we are personally defined by what we did not say, we then have to wonder what is shown to the rest of the world: the decision to say yes, or the decision to say no? By this I mean decisions in our past. We are defined by the world, by what option we picked: it all comes back to the yes or no.

It is not that we can make a decision to include a number in the set of transcendental numbers; rather it is a fact of numbers, a choice that was predetermined at some arbitrary point in the past and now it is just up to us to find them. Them. Them like people, like a binary code of 0s and 1s that when strung together represent something bigger: those choices that we were too young to make for ourselves and now too old to understand what is being asked. We as humans are being asked to pinpoint the moment that things first changed. *Find the x that satisfies this inequality. Find a function that represents this linear regression. Find. Find. Find.*

But in reality, I am looking in a mirror that reflects back several, hundreds, *thousands* of different versions of myself and I have to sit down and ask myself if this is a transcendental. Does this part of myself fall into a certain category? Can I be defined with these parameters?

Can it be shown that this is true using induction? I know I should exist, and that there are hundreds, thousands, millions of other people who are trying to find their transcendental number. I am trying to find myself in a list longer than can be conceived, and it is with that search that I fear completely losing myself. The anguish that lies in trying to resolve the difference between discovery and luck permeates into every crevice of our perimeters. Leaking from our pores like sweat, I am confined by my inability to distinguish the infinite from the finite.

And so I am living in an infinite perimeter.

An infinite perimeter full of misconstructions and skewed ideas of myself and others and this says something interesting about the nature of humankind. It says that the world is so full of people and each of us are imaginable, yet also constantly misimagined. We believe ourselves to be one thing, but we do not actually know if that one thing is being displayed to others the way we think it is. Because when we create ourselves, we give others the opportunity to completely destroy it. It is the one thing we can create on our own through the books we read, the expectations of our culture, and the people with whom we socialize. We are making ourselves inside of people when we talk to them or when we turn in a paper or offer help. And that my friend, is terrifying. When we think about the lighthouse in Virginia Woolf's *To The Lighthouse*, it is not the actual lighthouse that is pictured, but instead, it is each character's interpretation of what that lighthouse means in relation to themselves. For Mr. Ramsey, it is about standing strong against the waves; for Mrs. Ramsey, it is light, the absence of it, and what that leaves for the core; and for Lily, a picture, a snapshot of life among waves of change, and trying to find the right perspective with which to guide those boats home. What we gain is not from what is being imagined, but is more from the person doing the imagining. We can hear, travel, and imagine others, yet we can never fully become another.

We can never fully become another, but this idea that even the infinite can leak from our pores reminds us of an idea in mathematics related to fractal entities. Some fractals can be considered self-similar if when we "zoom in" very closely to a part of the fractal, it appears to look the same if we "zoomed out." So if we apply this concept to ourselves, no, I am not sweat coming out of a pore. Rather, I should be myself to everyone. My fingernails should say the same thing that my hand does, and so should my arm, and so on. We can combat this terrifying feeling of being a misimagined self by being content with this all or nothing type of life. We are fractal entities who contain so much more than what we let others see. Humanity cannot fully judge you if you keep this in mind. And only upon careful consideration can we look in the mirror and say exactly where a fractal started, in fact, it might even be impossible. This matters because creation is a continual process with several iterations. It is irrational, in both senses of the word, and it never ends. Our creation begins long before we enter into this world. The slate is blank at some point a la Lockean philosophy, but we cannot discover that original marking on this board.

So maybe it is not about what is labeled as a transcendental number or where the fractal started, but the people willing to look in the mirror and think critically about the beginning of it all. Maybe that is what matters, the fight. But does that not negate everything we are taught in mathematics programs in colleges and universities across the country? We are graded and assessed and forced to always find a solution for x, but what if that does not matter anymore? It is about being empathetic to the numbers left behind—those normal numbers. We have labels for all kinds of numbers: Mersenne primes, regular primes, even, odd, integers, irrationals. But between these sets lie the numbers with labels. It is like those moments when we create something, put it out into the space for judgment, and then wait for the response. Consider the

creation of the self. We when do this, we give others the opportunity to take the power from us and decide if it is valuable or not. And after spending days, months, or years on creating we are defined by the moments that we did not define using our own power. And if those numbers are humanity, then it is also about being empathetic with those people that we constantly misimagine.

Becoming another, this aspect of empathy, is the real reason for the masks. We try to place ourselves so infinitely close to another person that we will do anything in our power to make ourselves exactly like that person. It does not matter if this is a conscious decision or a habit or even a choice, but what matters is that it comes from an almost animalistic need for resolution, or the need for things to always return back to zero, to normal, to the time before negative numbers or exponential growth. This does not come from a need for the promise of power or wealth, but it does come from the need to reconcile our past relationships with our current ones. It is because our bodies and souls seek to be in a state of equilibrium that transcends relationships, distance, or what happened this morning. It is the reason apologies exist and boxes of chocolate can be found in the pharmacy down the street. It is also the reason why negative numbers and positive numbers are separated by zero. In Stanza 4 from "Song of Myself," Walt Whitman describes a variety of people and events that surround him and "[t]hese come to me days and nights and go from me again,/But they are not the Me myself." So these arbitrary occurrences in our lives that seem to populate and transform the world we live in do not appear to have any bearing on the person we choose to put forward to the rest of the world. Whitman then writes in Stanza 51: "The past and present wilt—I have filled them, emptied them,/And proceed to fill my next fold of the future" and this gives us a better view of ourselves in relation to others. While the past and present are not things that we consciously think about

every second of every day, they are what affects the next days—our future. The past and the present, which are things that we cannot tangibly hold, are what make us unable to become another person. We can only seek to create ourselves. A person is a collection of those instances in their past and their present, and without being able to hold, experience, and feel those parts of another person's life, we are completely unable to create something other than who we are.

But in this imagining of another person, we unintentionally discover more about ourselves than about the person we are imagining. And what we see is that we never fully make any connections to others at all; rather we make quick glances at people moving too quickly. These are like quick glances at numbers that populate a list too long for us to give any particular time to. Whitman describes this in Stanza 32: "Myself moving forward then and now and forever,/Gathering and showing more always and with velocity,/Infinite and omnigenous, and the life of these among them,/Not too exclusive toward the reachers of my remembrancers," and it is with this selection that we can begin to dissect what we discover about ourselves. The most interesting part of this statement is that Whitman juxtaposes the infinite and the omnigenous, and then proceeds to include everything within those two words. Processing too quickly between the infinite and the finite means that maybe the question we are asking gets lost in the disarray. When we step back, we can see the difference between the two, but when we are forced into making a decision about which one matters more to us, we are unable to. Within a single moment, we can define the infinite itself and the infinite in relation to others, and what this means for us is that we are setting forth with the intentions of being able to discern between the two, but when we are placed with the two choices in front of us, we cannot definitively distinguish either option.

Consider sitting in the set of transcendental numbers, to sit amongst an infinite set with no bounds. Can we separate the infinite itself and infinite we see to the right and left of our tiny body? We see ourselves—an infinite collection of pasts, presents, and futures moving at such a great velocity, and then we see others—a supposedly similar infinite collection but instead we only see a single layer, the layer the other person has placed in their mask for us to interact with. What this means for us then, is that we assume that the infinities are different sizes. There are infinitely many numbers between 0 and 1; there are infinitely many numbers between 0 and 2, and similarly between 0 and 10. We assume that for any arbitrary point in our lives that we are already at a point in the future that holds no connection to the first point; we incorrectly assume that these infinites do not intersect. Someone could be constructing their creation in the "0 to 10 infinity" while I am in the "0 to 3 infinity". We are intersecting each other from the zero to three set and this is the intersection of importance. This assumption creates a false sense of existence as the mind begins to overtake itself, unable to reconcile the idea that our different infinites do indeed overlap. Marcel Proust writes in "Swann's Way" that our mind is "face to face with something which does not yet exist, to which it alone can give reality and substance, which it alone can bring into the light of day" (Proust 2712). And so when we look at another person, it is not that we cannot become another person or seek to remember something with them, it is that we see in them the "vast structure of recollection" (Proust 2713). The vast structure of recollection is the structure we create, almost a catalog, used for remembering. And within that "0 to 10" infinity, maybe that person is at exactly 2.567 and in my "0 to 3 infinity," I am at 2.568. I can see a shade of myself in this other person's creation, thus being able to connect, but never become, my neighbor. When we look at others we do not see ourselves, but we instead see a shade of ourselves.

We can see our pasts in a lot of different objects, even, and Proust again describes this moment as being "this new sensation having had on me the effect which love has of filling me with a precious essence; or rather this essence was not in me, it *was* me" (Proust 2711). Lily Briscoe has a similar experience in *To The Lighthouse*. While trying to paint a picture of the landscape and the neighboring lighthouse, a feeling she cannot seem to shake, one described by fear, possible disappointment, and anxiety, plagues Lily but there is a moment when she senses that her companion on the beach, Mr. Carmichael, appears to be feeling the same things as she is. Mr. Carmichael is man of newer fame, having published a book of poems and several things he had written 40 years ago. In Mr. Carmichael, Lily sees a part of herself. The part she sees, though, is only what we can all see at first glance in others—the outline. She even talks about this feeling as thinking how many shapes one person might wear, and how they might appear in newspapers, but the person is the same as they have always been (Woolf 194). Lily connects with Carmichael in the sense that before Mrs. Ramsey died, during the dark period, and after they both returned, he never changed. Lily sees nothing beyond this point, nothing about what Carmichael believes in or stands for, but just that he had not changed. This is the same shade of Lily that the reader sees. There is a collective gasp when Lily returns to the dying house and sets forth reviving the place where she once stayed. The same shade here is that Lily and Carmichael both did not change.

Even the slightest changes can be hard to detect, and perhaps there is change here between these two characters, just like there is change in us. Lily and Carmichael represent the two kinds of people in this world: the Lilys want to try to force art to happen while the Carmichaels let art come to them. I am reminded of the question posed earlier that asks if it is more meaningful for mathematicians to label a number as transcendental or to go on the journey

to find one. For some, this journey is engrained so deeply that it becomes a quest. Like a knight from King Arthur's court, a mathematician rides and rides and rides his white horse. For me, the journey has never been as appealing as just having the numbers in front of me. Cathartic to say the least, the process of labeling numbers gives me the same euphoric sense of accomplishment as labeling people. Or art. Or words. Carmichael's growth is detailed through the use of parenthetical remarks, and it is almost as if this decision by Woolf is what adds to the aspect of letting art come to you. By placing Carmichael's main growth in these remarks, Woolf is hinting at the pure spectacle that letting art just come to you is.

There is a beauty in numbers. There is a beauty in knowing that 15 always comes after 14. That 3.1415926... will always be pi. That the Mandelbrot set is self-similar around Misiurewicz points. I do not have to worry about math growing old and becoming someone I do not want to look at. Mathematics is mostly linear, and from a young age, we are taught the steps needed to solve an equation, find the area of the garden, or figure out how many watermelons Roger gave Amanda. Few people have the chance to enjoy math for what it really is: a game. If the field is a game board and you are a bright yellow plastic piece, then each space you could land on is a mathematical idea. It is statistically impossible for you to land on every single piece because this would require you to roll a one x number of times consecutively. So you play this game of chance and hope you land on an idea that you like. It is a chase, you see. You keep wanting to play the game in the hopes that you land on a new space. Carmichael is the humanization of that, allowing us to enjoy waking up each day with a new page to fill with numbers, a new chance to let math create us instead of the other way around. But what happens in the middle that lets math grow?

Escaping X and Y

Carmichael also begins his journey in the dark and closes it with the war and his new poetry book. What happened in that darkness that made Carmichael aware and open to the art? Woolf alludes to it in the last remark: "[t]he war, people said, had revived their interest in poetry" (Woolf 134). No mention of Lily is made during these remarks, which means that she might not have experienced the suffering like Carmichael did. If we choose to claim that Carmichael's book represents humankind, then we can perhaps fashion ourselves when we are in the presence of others who are suffering. It can then be said, then, that our masks are a by-product of not our own suffering, but the suffering of others.

This is an interesting concept and what it means for us is that we are a constantly changing species. In T.S. Eliot's "The Love Song of J. Alfred Prufrock," the main character Prufrock feels this overwhelming sense of change, "Do I dare/Disturb the universe?/In a minute there is time/For decisions and revisions which a minute will reverse" (Eliot 45-48). In disturbing the universe, we are creating this perfectly imperfect suffering that gives others grief, but gives us a chance to define ourselves. And when all of us make these decisions daily, that is what causes these misconceptions and misimaginations of others. No clear picture of the people we believe in can ever be attained because of the cyclical nature of this process. It is easy, then, to become preoccupied with the obsession of suffering. To become immersed in something that ultimately creates so much peril for others just for your own personal gain is a lifestyle choice that seems to be suggested by this. Friedrich Nietzsche writes of this feeling in his second essay, "Guilt, Bad Conscience, and the Like" in his book *On the Genealogy of Morals.* He says, "...[b]ecause the *infliction* of suffering produces the highest degree of happiness, because the injured party will get in exchange for his loss...an extraordinary counterpleasure: the *infliction*

of suffering" (Nietzsche 41) and how powerful is that singular statement. We enjoy suffering because we get to inflict that suffering on others. It is the chance we all want to finally judge others like we have been judged. It is a chance to be on the other end of the sword. We gain joy from both the creation of ourselves and the actual inflicting of this pain on others.

By maintaining this cycle of judgment in a world that was not innately created with this intention, we ultimately force the suffering of some to overlap with the suffering of others. We simply cannot differentiate that many diverse suffering situations for every person we come into contact with. It is both logically impossible and it would be completely unreasonable to implement. So how then do we actually maintain this process? We maintain it by forcing others to create their own suffering. We do this by coercing others into their process of creation prematurely and then they become part of this eternal cycle of anguish. A good analogy for this would be when you are standing at the end of the diving board, knowing that your friends have just jumped off and loved the adrenaline rush but being unable to make your legs move so that you could feel the same thing. If we are forced off the end, we could hold resentment towards the person who pushed us. In a mathematical lens, it is similar to learning the processes before the theorems, and never really trusting that what you are doing is sound on a mathematical level.

Mr. Carmichael is the best representation of how this eternal cycle of anguish might become broken. At the end of *To The Lighthouse*, Mr. Carmichael and Lily talk and decide that Mr. Ramsey and the children have finally arrived at the lighthouse, but Mr. Carmichael's interesting choice of words lead us to another conclusion. He says "[t]hey will have landed" (Woolf 208) and this is in contrast to Lily's remark that just he (Mr. Ramsey) has landed. Besides of the obvious pronoun shift, Mr. Carmichael places the arrival of the boat to the lighthouse as a purely future-based statement, while Lily chooses to describe the arrival as a

moment that is now already in the past. Woolf continues describing Mr. Carmichael: "[h]e stood there as if he were spreading his hands over all the weakness and suffering of mankind; [Lily] thought he was surveying, tolerantly and compassionately, their final destiny" (Woolf 208). Like that ethereal moment between fate and the rhythm of your own heart, Mr. Carmichael was soothing the wounds of the past: the summer visitors, the days of not going to the lighthouse, and the endless heartbreak contained within Lily for Mrs. Ramsey. What Mr. Carmichael represents is the force that fights back against the suffering, the need we all have to reconcile ourselves to our own place in this world, to our own lighthouses. It is in these lighthouses that we find that one only needs a little light to see that our entire being does not have to be focused on a mask or the need to inflict suffering. It is in these lighthouses that we find that we all have a small slice of darkness within our core of light. Finding that slice rests on us resolving the precipice between landing and hoping to land—it means balancing progression and fortune.

Progression and fortune are two themes that reoccur in math history. There are several proofs for the Pythagorean Theorem, but it took years for that proof to bloom. Fermat's Last Theorem does not have that name for nothing. It took several years and lots of trial and error for Andrew Wiles to finally sketch a proof of it in the summer of 1993 in Cambridge, England. Edward Menkel was thrown into a mathematical world that he was uncomfortable with until he found himself in his work. Fortune and luck are two ideas that seem similar but are quite different. Discoveries may not always be founded on luck, but fortune can lead to remarkable breakthroughs. Progression and fortune are completely dependent on humanity's determination. It is a darkness that can sometimes consume you, but it a precipice that many enjoy landing on.

That slice of darkness within our own light becomes our identity. Because we have to rest on that precipice, our identity is constantly in jeopardy. It is also in jeopardy because it is always being created. Perhaps identity is less about the formation of the self and more about what is done with the remnants of a person's answers to a series of "yes or no" questions, something that Sartre discusses in his *Existentialism is a Humanism.* Choice and its effect on humanity is key in the discussion of the building blocks of our character. These blocks, and the changes we go through while answering important questions, create a foundation and transformation that has everything to do with math.

For mathematicians, it is not uncommon for us to deal with a problem that cannot be solved using the methods we already know. Many fields of mathematics, including calculus, require us to look at a problem from a different frame of reference or mindset. The same can be said for philosophy, and often words that were written several hundred years ago are taken into an altered view in a contemporary lens.

This change can perhaps be represented by a mathematical idea called a change of basis in the field of linear algebra. Bases in mathematics are an efficient set of building blocks for a space, and let's call that space V. The vectors $v_1, \ldots, v_m$ must be linearly independent in order to form a basis of V. The set of v_i's is not unique, but all qualifying sets have the same number of elements.

Remember this Sartrean view that we are composed of a series of "yes or no" questions? Our answers may not all be the same, but are the questions we are being asked the same? Have the questions been the same for thousands of years, proving these vectors to be linearly dependent, and thus, not the building blocks of society? This question requires an answer that allows for us to not be able to alter our futures—to change the basis. A future that changes every

second, every hour, every day would create new questions. Marcel Proust writes in "Swann's Way" of the interconnectedness we feel to ourselves and these questions, posing an interesting hypothesis about the relationship between the two: "And at once the vicissitudes of life had become indifferent to me, its disasters innocuous, its brevity illusory—this new sensation having had on me the effect which love has of filling me with a precious essence; or rather this essence was not in me, it was me." We become our questions, not our answers. We become what we seek to solve, just like a mathematician can spend years working on one problem and she becomes the problem. She wears it like a coat, visible for all to judge, but also admire. To adopt, but also shy away from. To find, but also hide.

The process of defining ourselves is a forced activity. Moments in life that require us to stand up for not only our beliefs, but also for our follies, demand us to have a clear understanding of who we actually are. *Persepolis* by Marjane Satrapi illustrates this innate desire in all of us to find ourselves in a world that is constantly telling us not to. She must find her building blocks, or her vectors, that will define her space. In a scene from the graphic narrative Satrapi breaks up with her boyfriend Markus. Satrapi feels so weak, and we can pick up on this instantly. Not only is she confused about what the future holds for her, but we are too. Satrapi is confined by this intangible feeling—not fully fear, not fully empathic but completely impalpable. Proust describes a similar feeling, continuing, "what an abyss of uncertainty whenever the mind feels that some part of it has strayed beyond its own borders; when it, the seeker, is at once the dark region through which it must go seeking, where all its equipment will avail it nothing. Seek? More than that: create. It is face to face with something which does not so far exist, to which it alone can give reality and substance, which it alone can bring into the light of day." What if our finite area is labyrinthine in nature, meandering against, between; next, beside; through, out of us

so delicately that we cannot put a finger on the feeling it creates, but we can feel our hearts racing rapidly at the thought of being lost within our own creation.

The linearly independent vectors that define a space, thus creating the basis, create the skeleton of our elaborate labyrinth. The fun, the getting lost that makes our hearts race with anticipation comes from the creation of linearly dependent vectors. Most of the time, these are scalar multiples of a "skeleton vector." How interesting is it that we can create infinitely many of these said vectors and we can trace and retrace our past steps. We can go back in time, if you will, and relive favorite memories. We can go back in time and choose to reimagine a difficult time in our lives as one with more positive outcomes. Dependent vectors give us the opportunity to get lost in the past, but always be reminded of our own core.

Dimension is a concept that many of us are familiar with, and maybe that is because of popular culture's insistence that movies be filmed in such a manner that you feel as if you are one of characters. Maybe it is because of our desire to become other people, and the phrase, "that is just a dimension of you" is our way of saying that there is much more behind the curtain. Regardless of the situation we choose to use the word in, dimension is something that not only mathematicians deal with. Those building blocks from before, those can be in different dimensions as well. Building blocks can come from our parents, our environment, or from our relationships with others. Consider a section from *To The Lighthouse*: "Did Nature supplement what man advanced? Did she complete what he began? ... That dream, of sharing, completing, of finding in solitude on the beach an answer, was then but a reflection in a mirror...the mirror was broken" (134). Trying to decipher this cryptic passage is difficult, but we can surmise that humanity looks for nature to supplement its own advancements. This brings into question the creation of the building blocks and if they can work together at all.

Emily Dickinson writes in her poem #690 "Forever – is composed of Nows –" about this idea that our identity and infiniteness are tied very closely to the future itself. Each moment in the past was at one time a moment in the future. Each moment in the future will be present—when it occurs. Therefore, every moment that has ever and that will ever exist in time was, is, or will be a present moment; a Now. Time moves forward in a very linear fashion, and even when it appears that we can live in the past with dependent vectors and our little infinities, we can only live in a single moment (until the next moment arrives). It is because of this that we can believe that the building blocks have to work together to create a harmonious self-concept. Aurelius also discusses this tiny infinity in *Meditations:*

> What a tiny part of the boundless abyss of time has been allotted to each of us—and this is soon vanished in eternity; what a tiny part of the universal substance and the universal soul; how tiny in the whole earth the mere clod on which you creep. Reflecting on all this, think nothing important other than active pursuit where your own nature leads and passive acceptance of what universal nature brings.

Just like the theories in mathematics often build from corollaries or previous theorems, great jumps cannot be made unless there is solid ground to land on. The misimagination of math is about breaking out of that linear shell in which mathematics resides. Too often, we expect mathematics to be about solving for x, plugging back in for y, and then graphing the function on the xy plane. What has that accomplished? In many cases, nothing. The misimagination of math allows us to create our own meaning in the curve of the integral sign. It allows us to find beauty in the contradictions. It allows us to map a world that changes the world. This brings

logic itself under scrutiny, so that the historic themes of axiomatization and generalization converge at the interface with philosophy and logic in the foundations of mathematics.

Historically as a people, we have axiomatized and categorized everything our hands have touched. We seek to generalize an entire population or group, but refuse to look at the logic behind it. The foundations of mathematics are about this process and the effort required to overturn this model equates to more than mass and acceleration. In recent years, mathematics has become much more theoretical and fun. Exploratory instead of concrete, mathematicians now have the ability to use philosophy to drive their decisions. This thesis is not about starting a revolution, but it is about taking core beliefs and applying them to your own field. The difference between right and wrong, deciding what is beautiful, and other universal truths can be discovered anywhere. My outlet to these ideas came through breaking numbers down into more manageable pieces. Mathematics, at its core, is about relating the known to the unknown. This same relation is between concepts in the humanities and in the philosophers I was reading about during my creation process. We know how to use our axioms, we have for thousands of years. We may also know how to apply the ideologies of the great men and women who have lived before us. Let us venture into the world of the unknown. Is that not what mathematics is all about?

Working on Both Sides of the Equation

What you do to one side of the equation, you have to do to the other.

I have heard this statement for years, but you do not understand the power of it until you try to work with an equation that does not have similar terms. For the past year (wow has it really been that long?) I have been working with an equation that did not make any sense. I was

setting the humanities equal to mathematics and trying to add Sartre to both sides, divide by linear algebra, and somehow interpret the result.

Well, this is it.

Converting the ideas from the humanities into words in mathematics is difficult, but certainly not impossible. It starts with boiling down ideas into words that are malleable and tangible, but still hold the same power as before. Words like anguish, suffering, and beauty lent themselves well to a discussion with mathematics. I say this not because you suffer through a hard proof or because a perfect score is beautiful. Mathematics is a process that is more than solving for x; rather it is a gateway into accessing a better, more efficient part of yourself. Like the dogwood blossoms outside my old bedroom window, it never changes, but forever repeats.

The process takes dedication to both sides. Spending too much time with one side of the equation means the other side gets weaker. I was fortunate enough to be with mathematics every day of my undergraduate degree; I was, and still am, surrounded by a faculty who push me (sometimes to the point of tears), champion me, and see beauty in my mistakes. I grew up on the fourth floor of Robert Bell in a windowless, concrete block of integral domains, slope fields, and inverse matrices. Mathematics, whether I liked it or not, was becoming a part of my soul.

When I graduated high school in 2011, I wanted to be an English teacher. I wanted to write the Next Great American Novel and dine with my favorite authors. I wanted to work with words. Four years later, and I am about to graduate college with my degree in Mathematics Teaching. I never thought I was excellent with words, but I did know that I could write a run-on sentence with the best of them. I found my voice after reading the works from Whitman, Satrapi, and Sartre. I found an even louder voice when I read the philosophies of Descartes and Kant, mathematicians with whom I was quite familiar. I was fascinated by how Descartes could be

both a master of geometry and a master of the humanities. So I began building a bridge between my two worlds the only way I knew how: by making some mistakes first.

I forged meaning where I could find it, and for a while, that meant looking at my mistakes as wins. There were days when it felt like no one understood the analogies I was making or the leaps I was trying to make between parametric equations and religion. But I kept going. I read up on theoretical mathematics and Cantor's work with infinite sets and tried to translate the mathematical jargon into something I could chew, and even then, it was hard to understand the mathematics behind much of what I was reading. I watched Youtube videos and talked to professors in the mathematics department. I tried to become the mathematician I always dreamed I could be. I remember having a dream that I was winning the Fields Medal, the highest award in the field. I wanted to believe that someone considered my ideas to be extraordinary and would change that mathematical world as we knew it.

I will never win that award, and let me tell you why: merging these two worlds makes people uncomfortable. I have been working on this thesis for over a year and I can count the number of interested responses I have gotten on one hand. I used to really hate that. I wanted my work to leave a mark on the world, to make an impact in my field. Instead, I live in this Uncomfortable State of Confusion and write on. Is that not what the core of creation is? To step out on a ledge and hope that through the hard parts you find something meaningful?

I am Carmichael.

I am living through this war right now, hoping that my words carry a weight greater than the bombs falling around me.

I used to think mathematics was this art form that refused to change even when the crosshairs of transformation were trained on it. Mathematics is changing every day. It is being

read, applied, construed, and manipulated to revive the interest of millions. It is the best love language in the world; some people can speak it, but everyone can feel it. New transcendental numbers are being discovered every day. Young mathematicians are being born right now. That is so exciting.

I have had the opportunity to create myself in the space between the collision of two massive worlds. Creating myself was terrifying at times, but I knew that I could look on my left and see a star exploding, throwing mathematical debris at me at great speeds and on my right I saw enormous pillars of philosophy looking down at me from the skies. I was bracing myself for the impact, and I never imagined that the craters I would be left with and how much they would mean to me.

I have been preparing for this goodbye over the past couple of weeks, but it is still hard. Just last week, I emailed one of my advisors and told him I was falling out of love with this thesis. I think it was because my thesis was changing every time I opened it. I had new ideas, new mathematics to apply and I could not keep up. This misimagination of mathematics is what I love. I love knowing that there is the same number of numbers between zero and one as there is between zero and two. I love knowing that I am contributing, even in a small way, to the field that terrified me just four short years ago.

So whether you are at 0.1 or 0.01 or 0.001, keep moving. Your forever composed of nows only lasts a split second before you move into the future. Misimagine while you can.

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